CLAIMS

I CLAIM:

1. A directional ion etching process for making angled features comprising:

providing a wafer substrate;

depositing a photoresist upon the wafer substrate;

masking the photoresist to provide at least one area of photoresist protected wafer substrate, the photoresist being developed to remove the photoresist from the non-protected area, thereby exposing at least one portion of the wafer substrate;

anisotropic ion etching about the remaining photoresist at a high angle relative to the wafer substrate to substantially remove at least a portion of the exposed portion of the wafer substrate;

removing the photoresist the photoresist from the protected area thereby providing at least one angled feature of material.

2. The process of claim 1, wherein the wafer is a silicon wafer.

3. The process of claim 1, further including depositing at least one layer of material upon the wafer substrate prior to depositing the photoresist.

4. A directional ion etching process for making angled features comprising:

depositing at least one layer of material upon a wafer substrate;

depositing a photoresist upon the material layer;

masking the photoresist to provide at least one area of photoresist protected material, the photoresist being developed to remove the photoresist from the non-protected area, thereby exposing at least one portion of the material layer;

anisotropic ion etching about the remaining photoresist at a high angle relative to the wafer substrate to substantially remove the exposed portion of the material layer;

removing the photoresist from the protected area thereby providing at least one angled feature of material.

5. The process of claim 4, wherein the material layer is a hard material.

6. The process of claim 5, wherein the hard material is selected from the group consisting of Silicon, Silicon Dioxide, Silicon Carbon, Silicon Nitride.

7. The process of claim 4, wherein the ion etching is accomplished by RIE.

8. The process of claim 4, wherein the angled feature is characterized by a length, a width and a height, the aspect ratio of the height to the length or width being substantially between 2 and 30.

9. The process of claim 4, wherein the at least one angled feature is cylindrical.

10. The process of claim 4, wherein the at least one angled feature is further characterized as having a base proximate to the wafer substrate and a top opposite from the base, the top being smaller than the base.

11. The process of claim 4, wherein prior to removal the remaining photoresist has a plurality of sides, the sides substantially defining the shape of the top of the angled feature, the sides further defining guides for the anisotropic ion etching.

12. The process of claim 11, wherein of the plurality of sides any two opposing sides may be substantially parallel.

13. The process of claim 11, wherein the etching angle for each side of the photoresist protected material is substantially between about 90 to 60 degrees relative to the surface of the wafer substrate.

14. The process of claim 11, wherein the anisotropic ion etching process comprises:

ion etching along substantially each side of the remaining photoresist at an angle, wherein the angle of etching may be different for each of the plurality of sides.

15. The process of claim 4, wherein the high angle relative to the wafer substrate is achieved by substantially tilting the wafer substrate as it is presented to an ion etching beam.

16. The process of claim 4, wherein the high angle relative to the wafer substrate is achieved by substantially tilting an ion etching beam as it is presented to the wafer substrate.

17. The process of claim 4, wherein the at least one provided angled feature is a silicon pillar.

18. The process of claim 4, wherein the deposited material is a patterned layer.

19. The process of claim 4, wherein the deposited material further comprises multiple patterned layers and conductive layers.

20. The process of claim 4, wherein the at least one provided angled feature is a vertical transistor.

21. A directional ion etching process for making angled features comprising:

depositing a silicon/polymer layer upon a wafer substrate;

depositing a photoresist upon the silicon/polymer layer;

masking the photoresist to provide at least one area of photoresist protected silicon/polymer, the protected silicon/polymer having a plurality of sides defining the top at least one angled feature;

developing the photoresist to remove the photoresist from the non-protected area, thereby exposing at least one portion of the silicon/polymer layer;

anisotropic ion etching about the remaining photoresist at a high angle relative to the wafer substrate to substantially remove the exposed portion of the silicon/polymer layer;

removing the photoresist from the protected area thereby providing at least one angled feature of material.

22. The process of claim 21, wherein the silicon/polymer is selected from the group consisting of Silicon, Silicon Dioxide, Silicon Carbon, Silicon Nitride.

23. The process of claim 21, wherein the ion etching is accomplished by RIE.

24. The process of claim 21, wherein the at least one angled feature is cylindrical.

25. The process of claim 21, wherein the at least one angled feature is further characterized as having a base proximate to the wafer substrate and a top opposite from the base, the top being smaller than the base.

26. The process of claim 21, wherein prior to removal the remaining photoresist has a plurality of sides, the sides substantially defining the shape of the top of the angled feature, the sides further defining guides for the anisotropic ion etching.

27. The process of claim 26, wherein of the plurality of sides any two opposing sides may be substantially parallel.

28. The process of claim 26, wherein the anisotropic ion etching process comprises:

ion etching along substantially each side of the remaining photoresist at an angle, wherein the angle of etching may be different for each of the plurality of sides.

29. The process of claim 26, wherein plurality of sides equals four, the anisotropic ion etching process comprises:

ion etching along substantially the first side of the remaining photoresist at a first angle;

ion etching along substantially the second side of the remaining photoresist at a second angle;

ion etching along substantially the third side of the remaining photoresist at a third angle; and

ion etching along substantially the fourth side of the remaining photoresist at a fourth angle.

30. The process of claim 21, wherein the wafer substrate is flexible.

31. A directional ion etching process for making angled features in a nanoimprinting template for use with a soft polymer comprising:

depositing at least one layer of undefined template material upon a wafer substrate;

depositing a photoresist upon the undefined template material layer;

masking the photoresist to provide a plurality of substantially identical photoresist protected areas, the photoresist being developed to remove the photoresist from the non-protected areas, thereby exposing and defining portions of the template layer;

anisotropic reactive ion etching at a high angle relative to the wafer substrate to substantially remove the exposed portions of the template layer; and

removing the photoresist from the protected area thereby providing a nanoimprinting template including a plurality of substantially identical angled features of template material,

wherein the angle of the features facilitates insertion and extraction of the nanoimprinting template.

32. The process of claim 31, wherein the wafer substrate is flexible.

33. The process of claim 31, wherein the template material is selected to be compatible with the soft polymer.

34. The process of claim 31, wherein the silicon/polymer is selected from the group consisting of Silicon, Silicon Dioxide, Silicon Carbon, Silicon Nitride.

35. The process of claim 31, wherein the at least one angled feature is cylindrical.

36. The process of claim 31, wherein the at least one angled feature is further characterized as having a base proximate to the wafer substrate and a top opposite from the base, the top being smaller than the base.

37. The process of claim 31, wherein prior to removal the remaining photoresist has a plurality of sides, the sides substantially defining the shape of the top of the angled feature, the sides further defining guides for the anisotropic ion etching.

38. The process of claim 37, wherein of the plurality of sides any two opposing sides may be substantially parallel.

39. The process of claim 37, wherein the reactive anisotropic ion etching process comprises:

ion etching along substantially each side of the remaining photoresist at an angle, wherein the angle of etching may be different for each of the plurality of sides.